ON THE TYPIFICATION OF LINNEAN SPECIES AS ILLUSTRATED BY POLYGALA VERTICILLATA

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So again a proposition of mine has come under censure in the pages of Rhodora,[1] and this time quite deservedly so! After publishing my account of "'Polygala verticillata' in Eastern North America" in 1931,[2] I realized that the situation had not been fully or correctly met, but I have hoped that a restudy of the matter in 1933, entitled "Polygala verticillata and the Problem of typifying Linnean Species,"[3] has adequately covered the ground. If Professor Fernald had consulted this paper, perhaps we would be nearer agreement. As he did not do so and as its argument seems to me worth bringing to the attention of readers of Rhodora, I ask his permission to discuss this special instance yet again.

Polygala verticillata forms an ideal text for considering the problem of typifying Linnean species, because on good logic the name may be assigned to any of *three* species. If one gives precedence to the description of the inflorescence the name must, as the late Kenneth K. Mackenzie contended,[4] be given to *Polygala ambigua* Nutt. If one takes as determinative the plant in Linnaeus' herbarium, the name must go, as Professor Fernald contends, to my *P. pretzii.* But if one studies the historical antecedents it passes, as I urged in 1931 and again in 1933, to what I have considered as true *verticillata* and Fernald as var. *isocycla.*

These three species in constancy of characters, lack of intergradation, and differing areas of occurrence seem to me amply distinct specifically. After a long probation *Polygala ambigua* is now generally so recognized. If their behavior in the Philadelphia area be indicative, the other two, although closely associated, must be given equal rank, and they will be so considered in this discussion. In the following key, which is repeated from the 1931 paper so as to bring clearly before us the characteristics of all three, these are contrasted. Since it does not affect the problem of typification, I have omitted *P.*

[1] Rhodora **40**: 395. Sept., 1938.
[2] Bartonia **13**: 7–17, *pl.* 2–3.
[3] Bartonia **15**: 38–45.
[4] In a letter received soon after the appearance of my 1931 paper. It was in reply to his suggestion that my second paper was written. He first called my attention to my stupid mistranslation of the phrase "spicis floribus remotis," saying that it could only denote *Polygala ambigua.*

verticillata sphenostachya, and slightly changed the characterization of *P. verticillata*. Illustrations of the three species, which I regret can not be reproduced here so that the reader may have them all equally before him, were given in Bartonia.

Raceme seemingly conic, the fruits soon falling so that the flowers and fruits present are crowded into a space 0.5–1.5 cm. long; 'wings' shorter than the mature capsule; seed about twice as long as wide, the aril usually over half its length; leaves mostly or wholly verticillate.
- Seed finely pubescent; capsule about 1 mm. long, on a pedicel ¼ to ⅓ its length; raceme narrow, dense, the sepals greenish-white; plant usually 1–2 dm. tall, with widely spreading branches and the racemes on peduncles 0.5–4 cm. long ..... *P. verticillata.*
- Seed hirsute; capsule about 1.5 mm. long, on a pedicel ⅓ to ½ its length; raceme wider and looser, the sepals often purplish; plant usually 2–3 dm. tall, with ascending branches and the racemes on peduncles 2–7 cm. long ..... *P. pretzii.*

Raceme long-cylindric, slender, the fruits more persistent so that the flowers and fruits present are scattered (the lower remote) in a very narrow slender raceme 1–5 cm. long; 'wings' about equaling the mature capsule; seed mostly thrice as long as wide, the aril usually less than half its length; leaves mostly or all alternate or scattered on the stem and virgate branches ..... *P. ambigua.*

For our problem let us next see the full wording of Linnaeus' original description of *Polygala verticillata*,[1] as published in 1753:

"*verticillata.* 21. POLYGALA floribus imberbibus, spicis floribus remotis, foliis linearibus verticillatis, caule herbaceo ramoso.

Polygala caulibus filiformibus, foliis linearibus alternis, pedunculis spicatis. *Gron. virg.* 172.

Polygala foliis imberbibus spicatis, caule erecto herbaceo filiformi ramoso, foliis linearibus. *Amoen. acad.* 2. *p.* 159.

Polygala mariana quadrifolia minor, spica parva albicante. *Pluk. mant.* 153. *t.* 438, *f.* 4.

Polygala quadrifolia minima marilandica, spicis florum parvis albentibus. *Raj. suppl.* 639.

Habitat in Virginia.

Folia *saepius quina ad genicula, interdum alterna. Spicae albae, angustissimae flosculis remotis.*"

Of this description the account of the inflorescence and the reference to Gronovius' "Flora Virginica," with the geographic statement of occurrence, all pertain to *Polygala ambigua.* 'Spikes with remote flowers' and 'Spikes white, very narrow, with remote little flowers' can only denote this species. Only this has the flowers truly white, a feature due to the expanded 'wings' of the perianth. Gronovius, who

[1] Species Plantarum 706.

it will be recalled was aided in Holland by Linnaeus in his younger days, based his polynomial[1] on John Clayton's number 563 from the Coastal Plain of Virginia, a specimen which I studied at the British Museum in 1930 and have since had verified anew by Mr. George Taylor of that institution. It is excellent *P. ambigua*, with the leaves nearly all alternate, the description (which may be counted as Linnaeus' own) showing that the slight whorling of those in the lowermost cluster had been overlooked. Evidently this alternate phyllotaxy was considered as atypical by Linnaeus, as in 1753 it was omitted from the essential diagnosis and only covered by the phrase "folia . . . interdum alterna"—'leaves sometimes alternate.' We are told that the species has its 'leaves usually[2] five to a node.' If Linnaeus had not placed such emphasis upon whorled phyllotaxy as especially characterizing his species, I should consider that its *ambigua* component should be accounted basic for *Polygala verticillata*.

In Linnaeus' own herbarium the only specimen of "Polygala verticillata," and that received, as Professor Fernald states, two years before the publication of the "Species Plantarum," was one gathered by Kalm at some unrecorded spot, but certainly much to the north of Virginia. It also I saw when in London in 1930. The specimen, which is my *P. pretzii*, shows well the whorled phyllotaxy demanded by Linnaeus' specific name. Professor Fernald considers it the true type. Why should we hesitate in assuming that this was the actual collection that was most carefully studied by Linnaeus for his account of *Polygala verticillata?*

Certainly it was not Kalm's plant from which Linnaeus drew his description of the inflorescence of *Polygala verticillata*, for we have just seen that this vital part of his diagnosis was based upon material of *P. ambigua*. We may well ask ourselves why, if he had Kalm's specimen before him, did Linnaeus ignore its flowers and describe instead another species which has not survived in the Linnean Herbarium at all. The most ready explanation is that, *at the time of drawing up his diagnosis for the "Species Plantarum,"* Linnaeus had not yet seen Kalm's plant, but had at hand either a specimen or notes[3]

[1] Flora Virginica 172. 1743.

[2] The force of "saepius," a comparative adverb, is stronger than 'often,' as translated by Professor Fernald.

[3] As it is said that Linnaeus sometimes gave away specimens when they had been replaced in his herbarium by better representation of the species concerned, it may be that the Clayton material was so discarded when that of Kalm was later added. Or it is known that in the later years at Hammerby many specimens had to be discarded

that described the inflorescence of Clayton's Virginia collection. The features descriptive of the latter are not quoted from Gronovius' "Flora Virginica," but are new information now first placed in print. So decidedly does Kalm's plant contradict this characterization that one suspects that, if the two collections had been actually compared for the diagnosis of the "Species Plantarum," Linnaeus would have realized their distinctions, and that the Virginia component need not have awaited description for nearly seventy years longer. But how is it possible that Linnaeus did not depend more upon Kalm's plants, since he had actually sent this student to North America and was eagerly awaiting what he would gather?

I gladly grant all Linnaeus' fostering interest in Kalm's travels. Kalm's collections were received in June, 1751, and so keenly interested was Linnaeus in them that we are told how, although previously quite sick, "he rose from his bed, and forgot his troubles."[1] There is no question of his having identified Kalm's plants, and having incorporated into the "Species Plantarum" a large number of new species from them. But this does not mean, as would be implied by Professor Fernald's emphasis upon the supreme importance of the Kalm plants, that Linnaeus overhauled the descriptions which he had already formulated so as to incorporate ideas from Kalm's specimens. Only on such an assumption can we reasonably accept Kalm's specimens as typifying Linnaeus' species, without first asking the question, "Was that description likely drawn before, or after, the incorporation of Kalm's material into Linnaeus' herbarium?"

Supposing any of us, who were incidentally as busy teachers as he, were engaged upon tasks so colossal and encyclopaedic as Linnaeus, is it likely that we could find time for drastic revisions as new material arrived? What was Linnaeus' normal course may be seen by comparing the same group through the several editions of his companion work, the "Genera Plantarum." This I have done for the Scrophulariaceae, and a study of the "Genotypes of the Scrophulariaceae in the First Edition of Linné's 'Species Plantarum'"[2] revealed the significant fact that once he had formulated the description of a genus it was rarely revised, but passed unaltered through each suc-

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because of damp or rodents. Or it may be that, even from the time of his visit to Holland from 1735 to 1738, Linnaeus had been assembling descriptive notes toward what later became his "Species Plantarum."

[1] Jackson, B. D., Linnaeus. p. 332. 1923.

[2] Proc. Acad. Nat. Sci. Phila. **82**: 9–26. 1930.

ceeding edition of the "Genera Plantarum."[11] Why this is so is evident enough when we consider the vastness of the tasks upon which he was engaged. Rarely indeed could he stop to revise or retouch his work.

I think that it is safe to assume that the parts of the "Species Plantarum" which were prepared before the summer or early autumn of 1751[12] will include only the new species based upon Kalm's collections, but rarely, if at all, old diagnoses modified to accord with his specimens. But the parts which were prepared after the incorporation of these specimens should show much dependence upon them, both for new and old species. Accordingly, we need to know what progress was being made by Linnaeus, and for our especial problem we wish to know just when he likely prepared his account of *Polygala verticillata.*

Perhaps full information of Linnaeus' progress on the text of the "Species Plantarum" is somewhere forthcoming, but all I have now at hand is what is given in Dr. B. Daydon Jackson's "Linnaeus."

[11] For the "Genera Plantarum" most generic descriptions commenced with the first edition in 1737, but my comparisons were made between the second edition in 1742 and the fifth in 1754. Linnaeus gave only generic descriptions, which were based wholly upon the structure of the flower and fruit. "These descriptions . . . rarely cover a whole generic concept, as do those of modern workers; only in the case of *Antirrhinum*, which was consciously built up of three earlier genera, *Linaria*, *Antirrhinum* and *Elatine*, am I certain that we have such a broad diagnosis." By comparing the generic diagnoses with the characters of the included species given in the "Species Plantarum" it becomes apparent—in those cases where there is appreciable floral contrast between the species—that the diagnoses fit only one or a few of the species. More than this, a study of what was available to Linnaeus makes it certain that his customary procedure was to select a certain illustrative species, and from it describe his genus. Thus, the diagnosis of *Veronica* was drawn from *V. officinalis*, which also on historical grounds should have been the genotype; *Gratiola*, similarly from *G. officinalis; Rhinanthus*, from *R. crista-galli; Pedicularis*, however, from *P. sylvatica*, etc. Evidently, his illustrative species were chosen with much care, and so they ideally meet the modern desire for typification of his genera. In fact, they may stand as Linnaeus' own selection of typical species for his genera. In only two cases in the Scrophulariaceae are they at variance with what subsequently became general usage. The diagnosis of *Bartsia* applies only to *B. coccinea*, thus making it evident that this name should have been continued for what we have come to call *Castilleja;* and that of *Gerardia*, a genus adopted from Plumier, applies solely to *G. tuberosa*, the species of Plumier which has since proved to belong to the Acanthaceae. In these cases I think that the names should either be assigned according to the species indicated by the generic diagnosis, or else rejected from nomenclature; surely no species should be chosen as typical of a genus which flagrantly contradicts the accompanying diagnosis of that genus! Efforts to typify Linnean genera have been too largely bibliographic and mechanical; it is to be regretted that Linnaeus' method in the "Genera Plantarum" was not realized long ago, and most of the species behind his diagnoses clearly revealed. (For a fuller discussion, with suggestions for procedure where floral characters are so uniform that no species is selected by the generic diagnosis, etc., the reader is referred to my paper of 1930.)

[12] Allowing requisite time for the sorting and preparation of Kalm's material after its arrival in June.

On page 273 we learn that the "Species Plantarum" was begun in 1746, and on it Linnaeus "laboured day and night" till 1748. Then he paused, but a year later he was again at work. "He reached *Poa* in a week; five months later he reached Icosandria. Early in 1752 he was engaged on Syngenesia, and in August of the same year, he thankfully recorded that he had finished writing the whole book." *Polygala* comes after Icosandria, but long before Syngenesia. Assuming a relatively even rate of progress this would seem to place its composition in the latter part of 1750 or the first half of 1751, thus somewhat before the probable incorporation of Kalm's plants. As this is in accord with the fact that Kalm's specimen was not used in characterizing the inflorescence, I think that we may reasonably infer that it reached Linnaeus too late to have played any part in his description of this species.

If he had not yet studied Kalm's plant, and if Clayton's plant does not meet the most important essential of Linnaeus' diagnosis, what had Linnaeus seen to make him adopt so positively the name *Polygala verticillata* for his species? Doubtless we go a step earlier in Linnaeus' thinking (since the views of his students were so largely his own reflected back to him) when we consult the thesis on "Radix Senega" by Jonas Kiernander, which was defended before Linnaeus at the University of Uppsala on April 8, 1749, then issued as a separate paper in 1749 or 1750, and which finally appeared in the Amoenitates Academicae in 1751. This is but a trivial step however, as, although the diagnosis lacks the "spicis floribus remotis" of Linnaeus' later one, it included the same citations as Linnaeus was to use, including that to Gronovius and so to the collection from which it seems likely that Linnaeus drew this bit of knowledge. So we may pass by Kiernander to his and Linnaeus' common antecedents.

Of the Linnaean citations there now remain only those to Plukenet and to Ray. "The details of their diagnoses are surprisingly alike, Plukenet's translating: 'Four-leaved smaller Maryland Polygala, with small whitish spike'; and Ray's: 'Four-leaved very small Maryland Polygala, with spikes of flowers small and whitish.' They might have been based upon the same collection, and so I believe they were. Leonard Plukenet, in his 'Almagesti Botanici Mantissa,' published at London in 1700, said a little more than Kiernander and Linnaeus later quoted, informing us that his plant was collected by Dr. Krieg; he further illustrated it in his "Almatheum Botanicum" of 1705,

showing its identity unmistakably. John Ray, in the third volume (or 'Supplementum') of his 'Historia Plantarum,' published at London in 1704, gave the diagnosis later quoted by Kiernander and Linnaeus, and added a remark that translates: 'This little plant is strongly branched, at the nodes of the stem sending out four or five narrow oblong little leaves. In the highest stems and branches it offers graceful oblong spikes, composed of whitish little flowers.' My reason for suspecting that this account was also based upon Krieg's collection is that in his preface Ray acknowledged indebtedness to Dr. David Krieg, a German, for plants gathered in Maryland. The date of Krieg's collection was probably little before 1700, as both Plukenet and Ray included his plant in lists supplementary to their main texts of some ten years earlier. Krieg's specimen is preserved at the British Museum, and Mr. Taylor assures me that it is wholly the first species of my paper of 1931, sustaining the identification that I had readily made from the illustration and texts. Both Plukenet's illustration and Ray's notes show that the leaves may be in fives as well as fours, thus modifying one word of their diagnoses to fit Linnaeus' remark of 'folia saepius quina'."

My conclusion now is the same as in 1933. "It is this element, the first-known historically, to which I still incline to apply the name *Polygala verticillata*. It does not fit Linnaeus' description of the flowering spike or his citation of locality, but I think that those difficulties are more than balanced by the emphasis that we should place upon the source of the name chosen. The 'Species Plantarum' has appealed to posterity as the beginning of nomenclature and descriptions, but it was not so to the master-botanist who composed it. Linnaeus felt himself a reformer, rather than originator; he was busied with assembling the many descriptions that preceded his work and organizing them under a simpler method of labeling. I think that he would have told us that his name 'verticillata' was here selected because it was more appropriate than was 'quadrifolia,' and that he thought of his species as being essentially the successor of that of Plukenet."

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